## MATH 326: Homework 10 <br> SPRING 2013

1. Suppose that I wish to start a new diet consisting of Raman noodles, ice cream (from Ferdinand's) and salad (from the Broiler). Each serving of Raman noodles costs $\$ 1$. Each serving of ice cream costs $\$ 2$ and each serving of salad costs $\$ 2$. Suppose that I wish to consume at least 2 servings of salad per day (for vegetables). I also wish to consume at least 1400 calories and 20 grams of protein. Each serving of Raman noodles contains 200 calories and contains 5 grams of protein. Each serving of ice cream contains 300 calories and contains 5 grams of protein. Each serving of salad contains 100 calories and 1 gram of protein. Assume I want to minimize the amount per day I spend on food.
(a) Construct a linear programming problem whose solution will provide the optimal diet for me.
(b) Use the Big-M method to find a solution for the problem.
2. Consider the Big-M problem formulation:

$$
P_{M} \begin{cases}\max & c^{T} x-M e^{T} x_{a}  \tag{1}\\ \text { s.t. } & A x+I_{m} x_{a}=b \\ & x, x_{a} \geq 0\end{cases}
$$

We noted that for a minimization problem the objective function would be:

$$
\begin{equation*}
\min c^{T} x+M e^{T} x_{a} \tag{2}
\end{equation*}
$$

We know that every maximization problem can be written as a minimization problem (and vice-versa). Show that equation (2) follows by changing Problem $P_{M}$ into a minimization problem.
3. Use any method you like to show that the following linear programming problem is infeasible:

$$
\begin{array}{cl}
\min & -x_{1}-3 x_{2}+x_{3} \\
\text { s.t. } & x_{1}+x_{2}+2 x_{3} \leq 4 \\
& -x_{1}+x_{3} \geq 4 \\
& x_{3} \geq 3 \\
& x_{1}, x_{2}, x_{3} \geq 0
\end{array}
$$

